REMARKS

The allowance of claim 26 is gratefully acknowledged.

Claims 1, 4, 13, 19, 23 and 25 have been amended. Claims 1-23 and 25-26 are pending in the application. Applicants reserve the right to pursue the original claims and other claims in this application and in other applications.

Claims 1-23 and 25 stand rejected under 35 U.S.C. 103 as being unpatentable over Jacot in view of Sandercock. The rejection is respectfully traversed.

Claim 1 recites a low-frequency vibration control system. The system includes "an electromagnetic actuator for selectively applying forces to a controlled structure at a first region of said controlled structure, said forces being adapted to interfere with corresponding forces received at a second region of said controlled structure." According to claim 1, the system includes "a digital control system for causing a force-linearized flux to be generated in a gap between said armature and said magnetic coil."

Applicants have previously argued why Jacot should not be combined with Sandercock and why, most importantly, even if the references were somehow combined, the cited combination fails to teach or suggest the claimed invention. These arguments are not repeated here. Applicants' prior amendment, Jacot and Sandercock, even when considered in combination fail to teach or suggest "causing a force-linearized flux to be generated" in a gap between an armature and a magnetic coil. These arguments are not repeated here.

Moreover applicants respectfully submit that the cited combination also fails to teach or suggest "an electromagnetic actuator for selectively applying forces to a

controlled structure at a first region of said controlled structure, said forces being adapted to interfere with corresponding forces received at a second region of said controlled structure" as recited in amended claim 1.

The Jacot reference discloses "a plurality of linear actuators pivotally connected between [an] aft body and [a] mounting member. The magnetic actuators support the forward body relative to the mounting member by magnetically supporting the armatures between paired stator cores in each stator." Jacot Abstract. Sandercock relates to a "piezoelectric displacement transducer, and means for linearizing the voltage-displacement characteristic of the piezoelectric displacement transducer with the first and second feedback signals." Sandercock Col. 3, ll. 26-37. Neither reference, however, teaches or suggests the "electromagnetic actuator for selectively applying forces to a controlled structure at a first region of said controlled structure, said forces being adapted to interfere with corresponding forces received at a second region of said controlled structure" of the present invention.

Applicants respectfully submit that the claimed invention's structure and that of the purported combined structure are very different. Jacot and Sandercock relate to active vibration <u>isolation</u>. As explained in prior amendments, the claimed invention relates to active vibration <u>cancellation</u>, which is very different than isolation. In addition, the claimed invention is dynamically very much more demanding to control.

When seeking to enhance vibration isolation, such as in the cited combination, an active controlled isolator is operating on the local point impedance of the structure to be isolated. In contrast, as is performed in the claimed invention, when implementing cancellation from a remote point, the relevant parameter becomes the transfer impedance from that remote point. A feature of point-impedance is that the associated phase must always lie in a sector +/- 90 degrees on either side of a pure

damping characteristic. In contrast, a transfer impedance can have phase characteristics which rotate a full 360 degrees or more. This fundamental difference has direct implications for control system stability, which is another reason why the claimed invention and the cited combinations are different.

The separate concepts of vibration isolation and vibration cancellation are distinct. Isolation involves introducing an element or elements, which may be active or passive, between the source of vibration and the receiver so that noise or vibration is prevented from traveling from the source to the receiver. In contrast, cancellation allows the vibration to pass freely from the source to the receiver, but additional vibration is introduced, often at an entirely different injection point so that the resultant sum of the unwanted vibration and the additional injected vibration represents a net reduction or attenuation of vibration.

The purpose of a high gain flux loop is to ensure that the flux observed at the sensor is closely equal to the value of flux that has been demanded. The flux in the magnet gaps is a function of both the current through the coils and the size of the gap. By incorporating a high gain flux loop, the current in the coil is automatically adjusted so that it compensates for any changes in gap and ensures that the values of achieved flux are defined by the input flux demand, and nothing else. The input to such a flux loop, however, is the flux demand. If the relationship between the actual flux and the resultant delivered force is non-linear, then the flux loop alone cannot correct for this non-linearity. The flux loop contains no information relating to the flux-force relationship.

In the present invention, the nature of the single-sided armature-magnet configuration is such that the force is directly proportional to the square of the flux. It is indeed a very non-linear relationship. For this reason, the control circuit includes a

specific process prior to the flux-loop where the square-root of the force demand is formed, and the flux demand is in turn defined from this square-root.

The resultant flux-demand and the achieved values of flux are then such that there is a linear relationship between the desired force and the delivered force. The flux itself is not linearly related to the force demand – the value of flux has been defined so as to linearize the demand-force to force-achieved relationship (a force-linearized flux). There is no disclosure of this concept in either of the two cited references.

The claimed invention uses vibration cancellation. In cancellation, where one waveform is linearly superposed on another, there is a requirement for linear actuation. For example, if the waveform to be cancelled is a sinusoid, then an actuator seeking to reproduce this an anti-phase sinusoid must be careful not to reproduce force harmonics, which would replace the unwanted vibration with vibrations of two or more times the frequency.

But in the context of vibration isolation (e.g., Jacot), where the objective is to minimize the fluctuating force connecting two bodies, it is sufficient to ensure that the flux variations are maintained as close as possible to zero. If the flux variations are extremely low, by definition the force variations will be extremely low, regardless of the precise flux-force relationship. The objective of driving flux variations to zero will automatically drive force variations to zero, since regardless of the relationship, the specific value "zero-fluctuation" is common to both. This is another reason why the claimed invention is different than the cited combination.

Applicants respectfully submit that the cited combination fails to disclose, teach or suggest the claimed invention. Accordingly, Applicants respectfully submit that claim 1 is allowable over the cited combination. Claims 2 and 3 each depend from

claim 1 and are allowable along with claim 1 for at least the reasons set forth above and on their own merits. Claims 4-23 and 25 also include similar limitations as claim 1. Therefore, for at least reasons given above with respect to claim 1, claims 4-23 and 25 are allowable over the cited combination.

The rejection should be withdrawn and claims 1-23 and 25 allowed.

In view of the above amendment, applicant believes the pending application is in condition for allowance.

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Respectfully submitted,

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